

RUSLE SUPPORTING PRACTICE INSTRUCTIONS, TABLES, AND FIGURES

RUSLE P SUBFACTOR VALUES FOR CONTOURING

STEP 1. GATHER APPROPRIATE INFORMATION:

1. Identify the hydrologic soil group for the selected profile soil.
2. Determine the length and slope gradient of the landscape profile, and grade along the furrows.
3. Identify the 10-year storm erosivity (10-yr EI) value for the site.
4. Select the Cover-Management Condition using Table 1, "Cover Management Conditions D".
5. Select the appropriate ridge height using Table 2, "Guidelines for Selecting Ridge Heights for Contouring with RUSLE".

STEP 2. DETERMINE THE P SUBFACTOR FOR CONTOURING "ON GRADE."

1. With 10-yr EI value, ridge height, hydrologic soil group, and cover-management condition, select the appropriate part of Table 3, "RUSLE Contour P Subfactor Tables for On Grade Condition".
2. Enter the selected table proceeding down the column for the hydrologic soil group and read the value in the row for the slope steepness. The resulting value is the P subfactor value for contouring "on grade".

STEP 3. ADJUST CONTOURING P SUBFACTOR FOR FURROW GRADE.

1. Calculate the ratio of the field's average furrow grade to its landscape profile slope used to describe the field's topographic factor and round to the nearest 0.1. Given that the furrow grade and landscape profile slope estimates are generally inexact estimates with only one significant figure, do not attempt for more precision by rounding to the nearest hundredth. For ratio values less than 0.05, go to step 4 as no adjustment is required for this "off-grade" contouring.
2. For ratio values of 0.05 and larger, go to Table 4, "Contouring P Subfactor Value Adjusted for Furrow Grade."
3. In the left-most column of Table 4, locate the P-factor value for on-grade contouring obtained from step 2 above. If the p factor value is an odd number, round up or down to the nearest even number listed in Table 4. Round in the opposite direction than you did when rounding the furrow grade to landscape profile slope ratio to the nearest 0.1.

On the located row, move right to the column for the appropriate ratio of furrow grade to slope steepness of the landscape profile. This value is the RUSLE p subfactor value for "off grade" contouring where the slope is less than the critical slope. Beyond the critical slope length, the practice effectiveness decreases quickly with greater slope length.

STEP 4. DETERMINE THE CRITICAL SLOPE LENGTH.

1. Refer to Figures 1-23 and select the applicable figure for the hydrologic soil group, and Cover- Management Condition 1-7.
2. Enter the. selected ,figure at the landscape profile slope on the horizontal axis and project a vertical line up to Intersect the 10-yr EI value (EI1 0) for the site. From that intersection project a horizontal line to the left and read the critical length. This is the critical length, which is the maximum slope for which the previously determined p subfactor value applies. Use the previously determined p subfactor value for slopes less than critical.
3. Strip cropping increases the effectiveness of contouring. When used in conjunction with contouring, increase the critical slope length by multiplying the value from b (above) by 1.5.

STEP 5. ADJUST THE CONTOURING P SUBFACTOR WHERE THE LANDSCAPE PROFILE EXCEEDS THE CRITICAL SLOPE LENGTH.

1. Where landscape profile slope exceeds the critical, divide the landscape profile slope length by the critical slope length. Be sure to increase the critical slope length if strip cropping applies. (The p subfactor value increases as a function of the ratio of landscape profile slope length to critical length where the ratio exceeds a value of one.)
2. Use the same rill/interrill ratio if used previously in determining the topographic (LS) factor at the site. Otherwise select the ratio from the following: Medium, when the interrill erosion and rill erosion are "balanced" which is the case for most cultivated cropland in row crops and small grains; Low, when most of the soil loss is caused by interrill erosion, which is the case for rangelands, pasture lands, and situations where consolidated soil is resistant to erosion; High where most of the erosion is rill erosion, which is often the case for construction sites immediately after disturbance.
3. Go to Figures 29-31. Select the appropriate figure with the rill/interrill ratio and the percent slope.
4. From the slope length/critical length ratio on the horizontal axis of the selected figure, project a vertical line to intersect the p subfactor value determined in step 2 or 3 above. From that intersection project a horizontal line to the left and read the effective p

subfactor value. This subfactor value is the corrected p subfactor value for contouring for the entire landscape profile slope length.

STEP 6. COMPUTE ROTATIONAL CONTOURING P SUBFACTOR WHERE COVER-MANAGEMENT CONDITIONS AND/OR RIDGE HEIGHTS CHANGE FROM YEAR TO YEAR DURING THE LIFE OF A CROP ROTATION.

1. Where the crop rotation planned for the field will cause cover-management conditions and/or ridge heights to change from year to year during the critical erosion period, calculate the average annual p subfactor. It is the weighted average of the p subfactors calculated for each cover management condition and ridge height presented during the critical erosion period for each year in the life of the rotation.
2. For each cover management condition and ridge height presented by each year in the crop rotation during the critical erosion period, calculate the contour p subfactor following the appropriate steps 1-5 above.
3. Multiply the contour p subfactor value for crops with the same cover-management condition and ridge height by the number of the years they occur in the rotation.
4. Sum these different sets of multiplied values and divide by the total years in the rotation to yield an average annual contour p subfactor value.

EXAMPLE A

STEP 1. GATHER INFORMATION.

- a) Hydrologic soils group B.
- b) Landscape profile slope = 6%, slope length = 150 feet. Furrow grade = 1 %.
- c) For the site near Lewiston, Maine, the 10-yr EI = 60, and the R value applies to the site.
- d) When row cropped, clean tilled com is grown. This is Cover-Management Condition 6.
- e) Ridges and furrows made during com planting range 3-4 inches in depth so they are Moderate Ridges.

STEP 2. DETERMINE THE P SUBFACTOR FOR CONTOURING II “ON GRADE.”

- a) In Table 3, Condition 6, EI=60 (10-yr StOm1 EI = 60, and Cover Management Condition 6), select the table for Moderate Ridge Height (3-4" Ridges).
- Find the column for hydrologic soils group B and the value in the intersected row for 6% slope. Read the p subfactor value of 0.21.

STEP 3. ADJUST CONTOURING P SUBFACTOR FOR FURROW GRADE.

- The furrow grade/slope grade ratio is calculated as $1.0/6 = 0.167$ rounded to 0.2.
- Go to Table 4 as ratio indicates a correction applies.
- Since Table 4 does not have a line for 0.21, round the value up or down between 0.20 and 0.22. Since the furrow grade/slope grade ratio was rounded up, round down this time to 0.20. Enter Table 4 with the on grade contouring p subfactor value of 0.20 and read across to the furrow grade/slope grade ratio of 0.2. The value is 0.56. It is the p subfactor value for "off grade" contouring where the slope is less than the critical slope.

STEP 4. DETERMINE THE CRITICAL SLOPE LENGTH.

- With Figure 10 for hydrologic soils group B, and Cover-Management Condition 6, and the 6% slope, read a critical length of 510 feet. The critical slope exceeds the 150-foot slope length at the site so the p subfactor value of 0.56 applies to the entire landscape profile slope length.

EXAMPLE B:

STEP 1. GATHER INFORMATION.

- Hydrologic soils group C.
- Landscape profile slope = 6%, slope length = 450 feet. Furrow grade = 1.0%.
- For the cropland site near Lewiston, Maine, the 10-yr EI = 60.
- When row cropped, clean tilled corn is grown. This is Cover-Management Condition 6.
- Only a ridge height of 2-3 inches is formed by tillage and planting equipment on this soil, a Low Ridge.

STEP 2. DETERMINE THE P SUBFACTOR FOR CONTOURING "ON GRADE."

- In Table 3, Condition 6, EI=60, select the table for Low Ridge Height (2-3" Ridges).
- Find the column for hydrologic soils group C and the value in the intersected row for 6% slope. Read the p subfactor value of 0.40.

STEP 3. ADJUST CONTOURING P SUBFACTOR FOR FURROW GRADE.

- Calculate the furrow grade/slope grade ratio by dividing $1/6 = 0.167$, round to 0.2. b) Go to Table 4 as ratio indicates a correction applies.
- Enter Table 4 with the on-grade contouring p subfactor value of 0.40. Read across to the furrow grade/slope grade ratio of 0.2; find 0.67. The p subfactor value of 0.67 is for "off grade" contouring where the slope is less than the critical slope.

STEP 4. DETERMINE THE CRITICAL SLOPE LENGTH.

- Select Figure 16 for hydrologic soils group C, and Cover-Management Condition 6.
- Enter with the 6% slope, read up to intersection of (EI) 10 = 60 and across to find a critical length of 380 feet. The profile slope length of 450 feet does exceed the critical slope length so adjust the p subfactor value of 0.67.

STEP 5. ADJUST THE CONTOURING P SUBFACTOR FOR CRITICAL SLOPE LENGTH.

- The slope length/critical length ratio is $450/380 = 1.2$.
- Select figure 30 that applies to the slope range (4.1%-12%) and the medium Rill/Interrill Ratio used to describe row cropped cropland.

- From the slope length/critical length ratio of 1.2 on the horizontal axis, project a vertical line to intersect the previously determined p subfactor value of 0.67 for the site. From that intersection project a horizontal line to the left and read the p effective subfactor value of 0.75. The value of 0.75 is the contouring p subfactor value that applies to the entire landscape profile slope length.

EXAMPLE C: COMPLETE ROTATION - CONTOURING

STEP 1. GATHER INFORMATION ABOUT CROP ROTATION. INCLUDE THE LENGTH IN YEARS, CROPS GROWN, RIDGE HEIGHT, IF ANY, CREATED DURING THE PRODUCTION YEAR, AND THE COVER MANAGEMENT CONDITION PRODUCED BY THE CROP PRODUCTION PRACTICES USED TO GROW THE CROP.

1. Crop rotation is 8 years long.
2. Crops are clean tilled corn after hay; no-till corn after corn; mulch till, 40% cover, soybeans after corn; mulch till spring oats, 10% cover, after soybeans; summer seeded alfalfa-timothy into oat stubble, 30% cover; followed by four years of alfalfa-timothy hay production years.
3. Landscape profile is 10 percent, slope length = 300 feet. Average furrow grade = 1 %. 10-yr EI = 70. Soil hydrologic group is B.
4. Ridge height = 3-4- for corn after hay, 2-3- for no-till corn after corn, 3-4- for soybeans after corn, 0.5-2- for oats after soybeans, 0.5-2- for hay seeding into oat stubble, and 4 years of alfalfa-timothy hay = no ridges.
5. Cover management condition of corn after hay = 6, corn after corn = 3, soybean after corn = 4, oats after soybeans = 5, alfalfa-timothy into oat stubble = 5, and alfalfa-timothy hay/haylage = 2.

STEP 2. CALCULATE THE CONTOUR P SUBFACTOR FOR EACH YEAR WHERE COVER MANAGEMENT CONDITION OR RIDGE HEIGHT CHANGE.

1. Furrow grade/profile grade = $1/10 = 0.1$ for all crops where ridges are formed.
2. Corn after hay, on-grade $p = 0.28$. Off-grade $p = 0.51$. Critical slope length = 240 feet. Correct for exceeding critical slope, contour p subfactor = 0.63, where $300/240 = 1.25$.
3. Corn after corn, on-grade $p = 0.30$. Off-grade $p = 0.52$. Critical slope length = 1000 feet.
4. Soybeans after corn, on-grade $p = 0.22$. Off-grade $p = 0.47$. Critical slope length = 1000 feet.
5. Oats after soybeans and alfalfa-timothy into oat stubble, on-grade $p = 0.54$. Off-grade $p = 0.69$. Critical slope length = 560 feet.
6. Alfalfa-timothy hay. No ridges present. Contour p subfactor = 1.0.

STEP 3. MULTIPLY EACH DIFFERENT YEARLY CONTOUR P SUBFACTOR TIMES THE NUMBER OF YEARS IT OCCURS IN THE CROP ROTATION.

0.63 X 1 = 0.63,
0.52 X 1 = 0.52,
0.47 X 1 = 0.47,
0.69 X 1 = 0.69, and
1.0 X 4 = 4.0.

STEP 4. SUM THE VALUES CALCULATED IN STEP 3 AND DIVIDE BY THE TOTAL NUMBER OF YEARS IN THE CROP ROTATION TO GET THE AVERAGE ANNUAL CONTOUR P SUBFACTOR FOR THE ROTATION.

1. Sum of the values in step 3. $0.63 + 0.52 + 0.47 + 0.69 + 4.0 = 6.31$.
2. Divide 6.31 by the number of years in the crop rotation (8). Average annual contour p subfactor for the crop rotation = $6.31/8 = 0.79$.

RUSLE P SUBFACTOR VALUES FOR STRIP CROPPING

STEP 1. GATHER INFORMATION. NOTE THAT MUCH OF THE INFORMATION IS ALSO USED FOR EVALUATING CONTOURING.

1. Identify the hydrologic soil group for the selected profile soil.
2. Determine the length and slope steepness of the landscape profile, and grade along the strip boundaries.
3. Identify the 10 year storm erosivity (10-yr EI) value for the site.
4. Determine the number of strips that can be laid across the landscape profile. A minimum of two full strip widths must fit on the slope.
5. For a strip pair, select the Cover-Management Conditions that will be opposite each other during the life of the crop rotation using Table 1, "Cover-Management Conditions." For sod based rotations, it also important whether or not hay is established by clear seeding or with a nurse crop. The seeding year with a nurse crop introduces a third cover-management condition.
6. Determine whether this is to be a contour strip crop layout (as close to level strip boundaries as possible), a field strip cropping layout (strips markedly off-contour occasionally), or a buffer strip crop layout (lower position stationary narrow sod cross slope strips alternate with wider tilled strips down the landscape profile). Sediment retarding strips and erosion prone strips on contour and field strip crop layouts switch

positions on the landscape profile during the life of the crop rotation employed on them.

7. If a buffer strip crop layout, consult with farmer on percentage of landscape profile to be occupied by buffer strips, not less than 15 feet wide. Table 5 is set up for 10 and 20 percent, but presented as crop strip to buffer strip ratios of 9: 1 and 4: 1. Note from Table 5 that there is little to be gained by going to 20 percent from a sheet and rill erosion standpoint. The minimum landscape profile length that can benefit from buffer strips is 150 feet.

STEP 2. DETERMINE THE P SUBFACTOR FOR STRIP CROPPING.

1. Determine the type of planned strip crop layout, number of strips, cover-management condition pairings, and, in the case of buffer strips, the percent of landscape slope occupied by buffer strips. Select the appropriate part of Table 5, "RUSLE Strip cropping P Subfactor Tables" as developed within the state. (If Table 5 cannot approximate the conditions, your state office will assist in the development of an appropriate subfactor for strip cropping.)
2. Locate the strip cropping subfactor value at the intersection of number of strips and the Cover-Management Conditions of the strips. (For buffer strips, enter the correct column for ratio of cultivated crop strip to buffer strip.) The value is the strip cropping p subfactor for slopes where the landscape profile slope length is less than, or equal to, the critical slope length.

STEP 3. DETERMINE CRITICAL SLOPE LENGTH.

1. Refer to Figures 1-23 and select the applicable figure for the hydrologic soil group, and Cover- Management Condition. Use the most erosive cover-management condition of the opposing strip pairs proposed for, or existing on, the slope to determine the critical slope length for strip cropping.
2. Enter the selected figure at the profile slope on the horizontal axis and project a vertical line up to intersect the 10-yr EI value (EI_{10}) for the site. From that intersection project a horizontal line to the left and read the critical length. Strip cropping increases the effectiveness of the contouring. Therefore, adjust the critical slope length from the figure by multiplying the value by 1.5.
3. The adjusted critical length is the maximum slope length for which the previously determined strip cropping p subfactor value applies. Use the previously determined strip cropping p subfactor value where the landscape slope is equal to or less than the adjusted critical slope length.

STEP 4. ADJUST THE STRIP CROPPING P SUBFACTOR WHERE THE LANDSCAPE PROFILE EXCEEDS THE CRITICAL SLOPE LENGTH.

1. Divide the landscape profile total slope length by the critical slope length. (The p subfactor value increases as a function of the ratio of total slope length to critical length where the ratio exceeds a value of one.)
2. Use the same rill/interrill ratio if used previously in determining the topographic (LS) factor at the site. Otherwise select the ratio from the following: Medium, when the interrill erosion and rill erosion are "balanced" which is the case for most cultivated cropland in row crops and small grains; Low, when most of the soil loss is caused by interrill erosion, which is the case for rangelands, pasture lands, and situations where consolidated soil is resistant to erosion; High where most of the erosion is rill erosion, which is often the case for construction sites immediately after disturbance.
3. Go to Figures 29-31. Select the appropriate figure with the rill/interrill ratio and the percent slope.
4. From the slope length/critical length ratio on the horizontal axis of the selected figure, project a vertical line to intersect the strip cropping p subfactor value determined in step 2. From that intersection project a horizontal line to the left and read the effective p subfactor value. The effective p subfactor value is the adjusted p subfactor value for contouring for the entire landscape profile slope length.

STEP 5. MULTIPLY THE CONTOUR P SUBFACTOR TIMES THE STRIP CROPPING P SUBFACTOR TO GET THE COMPOSITE P FACTOR FOR THE SHEET AND RILL EROSION CONSERVATION MANAGEMENT SUBSYSTEM.

1. When the critical slope is not exceeded for strip cropping, use the unadjusted for slope length contour p subfactor value determined earlier using the contour p subfactor instructions. Take the p subfactor for strip cropping times the contour p subfactor to get the composite p factor for the conservation management subsystem.
2. When the critical slope is exceeded for strip cropping, adjust the contour p subfactor value using the ratio determined by dividing the total slope length by the critical slope length for strip cropping. Go to figures 29-31, enter appropriate figure with this ratio and determine adjusted contour p subfactor. Take this adjusted contour p subfactor times the adjusted p subfactor for strip cropping to get the composite p factor for the conservation management subsystem.

EXAMPLE D:

STEP 1. GATHER INFORMATION FOR USE IN RUSLE.

1. Hydrologic soils group C.
2. Landscape profile slope = 6%, slope length = 450 feet. Strip boundary grade = 1 %.
3. For the site near Lewiston, Maine, the 10-yr EI = 60, and the R value applies to the site.
4. Four contour strips are planned with alternating Cover-Management Conditions 2 and 6. 2 is for hay. Hay is clear seeded. 6 is for clean tilled corn. Near equal acreage of corn and hay in every year of the crop rotation.

STEP 2. DETERMINE STRIP CROPPING P SUBFACTOR .

1. In Table 5, select the contour strip cropping practice p subfactor table for sod based rotations, clear, spring seeded hay. This table has a furrow grade of 0.5% (close to the 1 % actual row grade).
2. Locate the intersection of 4 strips and Cover-Management 2, 6. The value of 0.70 is the strip cropping p subfactor that applies for slopes less than or equal to critical.

STEP 3. DETERMINE CRITICAL SLOPE LENGTH.

1. With Figure 16 for hydrologic soils group C, and Cover-Management Condition 6, (EI₁₀) = 60, and the 6 % slope, read the critical length is 380 feet.
2. Multiply 1.5 X 380 to calculate the strip cropping critical length of 570 feet. The 450-foot slope length at the site is less than the critical length.

STEP 4. ADJUST THE STRIP CROPPING P SUBFACTOR FOR CRITICAL SLOPE LENGTH.

None required in this example.

STEP 5. MULTIPLY CONTOUR P SUBFACTOR TIMES STRIP CROPPING P SUBFACTOR TO GET COMPOSITE P FACTOR .

1. From example B, contouring p subfactor was determined to be 0.67.

Note that this is the contour p subfactor for the corn cover-management condition, not a weighted average p subfactor for corn and hay cover-management conditions. Corn or cover management condition 6 is always present in the field somewhere. So cover-

management condition 6 is continually in the field, it just alternates in position back and forth between strip pairs.

2. From this example, the contour strip cropping p subfactor was 0.70.
3. Multiply the two subfactors together, $0.67 \times 0.70 = 0.47$. The p factor for this field's contour strip cropping system is 0.47.

RUSLE P SUBFACTOR VALUES FOR TERRACING

STEP 1. GATHER INFORMATION FOR USE IN RUSLE.

1. Determine the slope gradient of the landscape profile. Will it change with construction of terrace? If yes, determine new slope gradient.
2. Identify the R value for site being evaluated.
3. Determine what supporting conservation practice will accompany the terraces, contouring or contour strip cropping.
4. Determine terrace horizontal spacing interval using Table 2 from page 600-2, NHCP, Terrace conservation practice standard, as a guide. Check maximum and minimum spacing requirements for the proper slope and R value ranges. Minimum spacing interval given at bottom of Table 2. If terrace(s) will be used in conjunction with contour strip cropping, read across to spacing interval in feet under With Contour Strip cropping column.
5. Decide whether terrace will have an open or closed outlet.
6. If an open outlet, decide channel grade of terrace at outlet end. If channel grade is 0.8 or greater, skip step 2. Practice factor equals 1.0. Do proceed with step 3, however.

STEP 2. DETERMINE TERRACE P SUBFACTOR .

1. Enter Table 1 from page 600-2, NHCP, Terrace conservation practice standard. Select proper horizontal spacing interval range row. Read across to the selected outlet type. If an open outlet is the design choice, then select the terrace channel grade range column that describes the design terrace channel grade. Read the P subfactor value at the row-column intersection.

STEP 3. IF TERRACE HORIZONTAL SPACING INTERVAL IS LESS THAN LANDSCAPE PROFILE SLOPE LENGTH, RECALCULATE LS VALUE TO REFLECT SHORTER SHEET AND RILL EROSION FLOW LENGTH.

1. Check original landscape profile length. If terrace horizontal spacing interval is less the LS value must be recalculated.

2. If significant earth moving will cause a change in landscape profile slope, recompute landscape profile slope, record new slope and use in step c.
3. Enter appropriate Ls table with terrace spacing interval length by going across table column heading until slope length in feet approximates terrace interval. Read down column until you intersect correct percent slope. This is the new adjusted LS factor value. Enter this value in place of the original value estimated before terraces were used to split the original landscape profile. If terrace spacing falls between two slope length column headings, interpolate for more precision, if desired.

STEP 4. DETERMINE COMPOSITE P FACTOR FOR TERRACING WHEN USED IN COMBINATION WITH CONTOURING ALONE, OR WITH CONTOURING AND STRIP CROPPING.

1. When terraces are used in conjunction with contouring, multiply terrace p subfactor times the , contouring p subfactor to get the composite p factor.
2. When terraces are used in conjunction with both contouring and strip cropping, multiply all three p subfactors together to get the composite P factor .

EXAMPLE E:

STEP 1. GATHER INFORMATION.

1. Landscape profile = 6%. Will not change with construction of terrace.
2. For the site near Lewiston, Maine, the R factor = 95.
3. Contouring will be used. Row grades will parallel terrace channel.
4. Horizontal spacing interval selected is 150 feet. Will split landscape profile slope length into thirds (originally 450'). This is the minimum spacing allowed by Table 2, page 600-2 Terrace.
5. Open outlet selected. Terraces will outlet into stone center waterway.
6. Terrace channel grade will be 0.5%.

STEP 2. DETERMINE P SUBFACTOR FOR TERRACING.

1. In Table 1, page 600-2 Terrace, find horizontal interval range 140-180 and read across to Open Outlets, with percent grade of 0.4-.0.7. Read the p subfactor value of 0.9.

STEP 3. ADJUST LS VALUE.

1. Horizontal terrace spacing interval = 150'. This one third of the original landscape profile slope length. Adjust LS factor value and re-enter new value into the general RUSLE equation. Original LS = 1.49.
2. No appreciable change in the landscape profile slope is expected. Continue to use 6%.
3. Enter LS table for moderate ratio of rill to interrill erosion. Find the column for 150 feet of slope length and the value in the intersected row for 6% slope. Read the new LS value of 0.93. Enter this new value into the general RUSLE equation.

STEP 4. DETERMINE COMPOSITE P FACTOR.

1. a) Contour p subfactor is based on a low ridge, 10 yr. El = 60, C soil hydrologic group, and 0.5% row grade. Off-contour p subfactor = 0.59.
2. b) Multiply terrace p subfactor 0.9 times off-contour p subfactor 0.59. Composite p factor = 0.53.